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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/526,656	03/15/2000	Niko Pagoulatos	004735.P001	1231

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EXAMINER
CHAWAN, SHEELA C
ART UNIT
PAPER NUMBER

#5

2625

DATE MAILED: 03/12/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.
09/526,656

Applicant(s)
Niko Pagoulatos

Examiner
Sheela Chawan

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on _____
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above, claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 19 is/are allowed.
- 6) ☒ Claim(s) 1-3, 5-7, 9, 11, 12, and 14-18 is/are rejected.
- 7) ☒ Claim(s) 4, 8, 10, and 13 is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on Mar 5, 2000 is/are a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
*See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s). 4 6) ☐ Other:

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DETAILED ACTION

Drawings

1. The drawings are objected to because of draftsman's remarks (see attached PTO-948 paper number 5). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Allowable Subject Matter

2. Claims 4, 8, 10, 13 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Regarding claims 4 and 13, the prior art fails, to teach the method wherein the magnetic position sensor comprises a receiver and a transmitter, the method further comprising:

transforming the coordinate space associated with images of the second modality to a coordinate space of the receiver;

transforming the coordinate space of the receiver to a coordinate space of the transmitter;
and

transforming the coordinate space of the transmitter to the coordinate space associated with images of the first modality.

Regarding claim 8, the prior art fails, to teach the method wherein the position sensor comprises a receiver and a transmitter and wherein registering the coordinate space associated

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with images of the second modality to the coordinate space of the magnetic position sensor comprises:

- performing a transformation of coordinates of images associated with the second modality to the coordinate space of the receiver; and

- performing a rigid-body transformation from the coordinate space of the receiver to the coordinate space of the transmitter.

Regarding claim 10, the prior art fails, to teach the method of claim 1 wherein the magnetic position sensor includes a receiver and a transmitter, the method further comprising performing a calibration operation comprising:

- obtaining a first coordinate transformation between coordinate spaces of the receiver and transmitter;

- obtaining a second coordinate transformation between the coordinate space of the transmitter and a coordinate space of a target region, based on point fiducial positioned adjacent to the target region;

- obtaining a third coordinate transformation between a coordinate space of images associated with the second modality and the coordinate space of the target region, based on N-fiducial positioned within the target region; and

- based on the first, second, and third coordinate transformations, calculating a fourth coordinate transformation to associate the coordinate space of images associated with the second modality with the coordinate space of the receiver.

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Allowable Subject Matter

3. The following is an examiner's statement of reasons for allowance:

4. Claims 19-21, are allowed because none of the prior art including Schneider (US.6,351,573), Bucholz (US.5,383,454) fails to teach or suggest, alone or in combination, with every element of the claim. The present invention is directed to the field of the image processing, and in particular, relates to interactively registration ultrasound and magnetic resonance images. Claim 19, recites a method of calibrating a magnetic position sensor having a receiver and a transmitter, the method comprising:

obtaining a first coordinate transformation between coordinate spaces of the receiver and transmitter;

obtaining a second coordinate transformation between the coordinate space of the transmitter and a coordinate space of a target region, based on point fiducial positioned adjacent to the target region;

obtaining a third coordinate transformation between a coordinate space of images associated with an imaging modality and the coordinate space of the target region, based on N-fiducial positioned within the target region; and

based on the first, second, and third coordinate transformations, calculating a fourth coordinate transformation to associate the coordinate space of images associated with the imaging modality with the coordinate space of the receiver. Therefore, it is for this reason and in

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combination with all other limitations in the claims , that claims 19-21, are allowable over the prior art of record .

Claim Rejections - 35 U.S.C. § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103© and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 1-3, 5-7,9, 11,12,14-18, are rejected under 35 U.S.C. 103(a) as being unpatentable over Schneider (US.6,351,573), in view of Bucholz (US.5,383,454 , Listed in IDS paper # 4) .

As per claims 1 and 12, Schneider teaches a method, comprising:

registering a coordinate (column 6, lines 66- 67, column 7, lines 1 - 4) space associated with images of a first modality (column 4, lines 50-52, 54-55 , column 5, lines 40- 42)to a

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coordinate space of a magnetic position sensor (column 6, lines 1 - 4, 41-44, column 8, lines 33-56,)to obtain a first transformation (column 6, lines 59- 63);

registering a coordinate space associated with images of a second modality to the coordinate space of the magnetic position sensor, to obtain a second transformation (column 4, lines 55-67, column 7, lines 15- 29); and

Regarding claims 1 and 12 Schneider discloses an imaging device and method and, in particular, to a medical imaging device and method. Schneider performs a sort of Transformation process in an image such that it is translated (moved in a translational fashion), rotated (in two or three dimensions), scaled, sheared, warped, placed in perspective or otherwise altered according to specified criteria. However, Schneider do not explicitly discloses converting coordinates of images associated with one of the modalities to coordinates of images associated with the other one of the modalities based on the first and second transformations. However, Bucholz discloses a system which can determine the position of a probe within a head and display an image corresponding to the determined position. The system comprises of :

converting coordinates of images associated with one of the modalities to coordinates of images associated with the other one of the modalities based on the first and second transformations (fig 3C, column 4, lines 26- 57, column 5, lines 5-22, column 8, lines 52- 65), as shown by Bucholz the use of converting coordinates of images ... , because to calculate a specific position within the brain, and a target picked out on the specific image can be approached with a fair degree of accuracy during the surgical procedure (column 3, lines 45- 53) .

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Therefore, it would have been obvious to one with ordinary skill in the art at the time of invention to incorporate the teaching as taught by Bucholz 's into the system of Schneider, because, one with ordinary skill in the art would realize that this modification would help to calculate a specific position within the brain, and a target picked out on the specific image can be approached with a fair degree of accuracy during the surgical procedure, as suggested by Bucholz at (column 3, lines 45- 53) .

As per claim 2, Schneider teaches the method of claim 1 wherein the first modality comprises a magnetic resonance system (column 1, lines 34- 59, column 5, lines 40- 43) .

As per claim 3, Schneider teaches the method of claim 1 wherein the second modality comprises an ultrasound system (column 1, lines 34- 59, column 5, lines 40- 43) .

As per claims 5 and 14, Bucholz teaches the method of claim 1, further comprising superimposing images associated with the first and second modalities based on the converted coordinates (note, superimposing or combining the images of the scanning coordinate system (e.g., CT, MRI, PET), which is performing the scanned image coordinate system within which a reference plane RP can be defined by at least three reference points RP1, RP2 and RP3 located on the head 124 of the patient. A computer is then used to calculate a specific position within the brain and a target picked out on the specific image can be approached with a fair degree of accuracy during the surgical procedure , fig 4, column 3, lines 44-53, column 5, lines 5- 22) .

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As per claim 6, Schneider teaches the method of claim 1 wherein registering the coordinate space associated with images of the first modality to the coordinate space of the magnetic position sensor comprises:

positioning point fiducial markers adjacent to a target space, the point fiducial markers having first coordinates belonging to the coordinate space associated with images of the first modality (column 6, lines 5- 9, column 8, lines 22- 32, 57- 65) ;

localizing the first coordinates of the point fiducial markers to corresponding coordinates of the magnetic position sensor, to obtain second coordinates (column 12, lines 18- 30, column 13, lines 32- 40 , 50- 67, column 14, lines 1 - 15); and

deriving the first transformation based on the first and second coordinates (column 5, lines 54- 67, column 6, lines 1 - 4, column 7, lines 15- 29).

As per claims 7 and 15, Bucholz teaches the method of claim 1 wherein the magnetic position sensor comprises a transmitter and a receiver mounted on an object, the method further comprising:

calibrating the magnetic position sensor by determining coordinates of a point on the object with respect to a coordinate space of the receiver (note, calibrating the position of the probe based on the coordinates system , column 5, lines 25- 68);

determining the coordinates of the point on the object with respect to a coordinate space of the transmitter by using a rigid-body transformation (column 6, lines 8- 44, column 10, lines 3- 18).

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As per claim 9, Schneider teaches the method of claim 1, further comprising using an interpolation method to determine coordinate point intensity in images obtained using the first and second transformations (column 2, lines 55- 67, column 6, lines 10- 15, column 9, lines 15- 29) .

As per claim 11, Schneider teaches the method of claim 1, further comprising determining a registration error (column 6, lines 5-9, 66- 67, column 7, lines 1 - 4) .

As per claim 16, Bucholz teaches the apparatus of claim 12 wherein the magnetic position sensor comprises a transmitter and a receiver mounted to an ultrasound probe (column 5, lines 25- 68, column 7, lines 19 - 61).

As per claim 17, Bucholz teaches the apparatus of claim 12, further comprising an ultrasound scanner communicatively coupled to the processor to generate images associated with the second modality (fig 3C, column 8, lines 52- 65) the control unit being capable of cooperating with the processor to continuously change the second transformation while the ultrasound scanner generates images as the probe moves freely in a three-dimensional space (column 8, lines 52- 65, column 10, lines 3- 21).

As per claim 18, Bucholz teaches the apparatus of claim 12, further comprising a localization tool coupled to the magnetic sensor , the control unit being capable of cooperating with the processor to obtain the first transformation by localizing coordinates of a point on the localization tool with corresponding coordinates of the magnetic position sensor (column 3, lines 5- 9, 28-33, column 5, lines 5- 22).

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Other prior art cited

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Kormos et al., (US.5,682,890) discloses magnetic resonance stereotactic surgery with exoskeleton tissue stabilization .

Kalfas et al., (US. 5,517,990) discloses stereotaxy wand and tool guide.

Kelly et al., (US. 5,787,886) discloses magnetic field digitizer for stereotactic surgery .

King (US. Re. 30,397) discloses three-dimensional ultrasonic imaging of animal soft tissue.

Grimson et al., (US.5,531,520) discloses system and method of registration of three-dimensional data sets including anatomical body data.

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Contact Information

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sheela Chawan whose telephone number is (703) 305-4876.

If attempts to reach the examiner on Monday through Thursday from 8:30 a.m. to 5:00 p.m. by telephone are unsuccessful, the examiner's supervisor, Bhavesh Mehta, can be reached at (703) 308-5246.

Any response to this action should be mailed to:

Commissioner of Patents and Trademarks

Washington, D.C. 20231

or faxed to:

(703) 872 - 9314, (for formal communications intended for entry)

Or: Any inquiry of a general nature or relating to the status of this application should be directed to the Group Receptionist whose telephone number is (703)305- 4750.

sc

Sheela Chawan
Patent Examiner
Group Art Unit 2625
March 7, 2003

Timothy M. Johnson
TIMOTHY M. JOHNSON
PRIMARY EXAMINER